SIAscopy Research Papers… a distillation of key findings

The shortened research findings contained within this briefing paper have been taken from various published research papers on SIAscopy. The full text of these research publications can be found on our web-site at; http://www.medxhealth.com/Skin-Assessment/Clinical-Trials-and-Studies/dermatology-white-papers.aspx

1) A novel imaging technique as an adjunct to the in vivo diagnosis of nonmelanoma skin cancer

H. Tehrani, J. Walls, G. Price, S. Cotton, E. Sassoon and P. Hall

British Journal of Dermatology 2006 155, pp1177-1183

Background; Spectrophotometric intracutaneous analysis (SIAscopy) is a light-based imaging system capable of producing rapid images of melanin, blood and collagen of the skin. Although the SIAscope has been investigated for melanoma diagnosis, no formal study has been conducted to determine its use in the diagnosis of nonmelanoma skin cancer (NMSC).
Objectives: A prospective study was conducted to investigate the potential for the SIAscope to diagnose NMSC.
Methods: In total, 302 consecutive patients were recruited into the study, 363 lesions being scanned. Logistic regression analysis was used to construct a predictive model for NMSC diagnosis and receiver–operator characteristic curves were used to assess overall accuracy of the model.
Results: A sensitivity of 98.0%, specificity of 95.7% and overall accuracy of 98.2% was found for NMSC diagnosis by the SIAscope model.
Conclusions: Results suggest that the SIAscope may be a useful adjunct in the diagnosis of NMSC.

2) Accuracy of SIAscopy for pigmented skin lesions encountered in primary care: development and validation of a new diagnostic algorithm

Jon D Emery, Judith Hunter, Per N Hall, Anthony J Watson, Marc Moncrieff, Fiona M Walter
BMC Dermatology 2010, 10:9

Abstract
Background: Diagnosing pigmented skin lesions in general practice is challenging. SIAscopy has been shown to increase diagnostic accuracy for melanoma in referred populations. We aimed to develop and validate a scoring system for SIAscopic diagnosis of pigmented lesions in primary care.
Methods: This study was conducted in two consecutive settings in the UK and Australia, and occurred in three stages: 1) Development of the primary care scoring algorithm (PCSA) on a sub-set of lesions from the UK sample; 2) Validation of the PCSA on a different sub-set of lesions from the same UK sample; 3) Validation of the PCSA on a new set of lesions from an Australian primary care population. Patients presenting with a pigmented lesion were recruited from 6 general practices in the UK and 2 primary care skin cancer clinics in Australia. The following data were obtained for each lesion: clinical history; SIAscan; digital photograph; and digital dermoscopy. SIAscans were interpreted by an expert and validated against histopathology where possible, or expert clinical review of all available data for each lesion.

Results: A total of 858 patients with 1,211 lesions were recruited. Most lesions were benign naevi (64.8%) or seborrhoeic keratoses (22.1%); 1.2% were melanoma. The original SIAscopic diagnostic algorithm did not perform well because of the higher prevalence of seborrhoeic keratoses and haemangiomas seen in primary care. A primary care scoring algorithm (PCSA) was developed to account for this. In the UK sample the PCSA had the following characteristics for the diagnosis of suspicious ': sensitivity 0.50 (0.18-0.81); specificity 0.84 (0.78-0.88); PPV 0.09 (0.03- 0.22); NPV 0.98 (0.95-0.99). In the Australian sample the PCSA had the following characteristics for the diagnosis of suspicious': sensitivity 0.44 (0.32-0.58); specificity 0.95 (0.93-0.97); PPV 0.52 (0.38-0.66); NPV 0.95 (0.92-0.96). In an analysis of lesions for which histological diagnosis was available (n = 111), the PCSA had a significantly greater Area under the Curve than the 7-point checklist for the diagnosis of melanoma (0.83; 95% CI 0.71-0.95 versus 0.61; 95% CI 0.44-0.78; p = 0.02 for difference).
Conclusions: The PCSA could have a useful role in improving primary care management of pigmented skin lesions. Further work is needed to develop and validate the PCSA in other primary care populations and to evaluate the cost-effectiveness of GP management of pigmented lesions using SIAscopy
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3) Assessment of SIAscopy in the triage of suspicious skin tumours

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Skin Research and Technology 2014; 0:1–5 doi: 10.1111/srt.12138

Background/purpose: Spectrophotometric Intracutaneous Analysis (SIAscopy) is a non-invasive, computerized technique for the diagnosis of pigmented skin tumours. The analysis is based on the evaluation of skin chromophores, i.e. melanin, haemoglobin and collagen within the epidermis and papillary dermis. Our aim was to assess the diagnostic validity of SIAscopy in the detection of melanoma and non-melanoma skin cancers compared to the clinical-dermoscopic diagnosis and the histopathologic results of the excised lesions.
Methods: In total, 188 lesions of 180 patients were examined by dermoscopy and SIAscopy. A SIAscopy scoring system was first compared with the clinical-dermoscopic diagnosis and then with the histopathologic diagnosis of the excised lesions.
Results: With respect to the clinical-dermoscopic evaluation, SIAscopy had sensitivity and specificity values of 85.7% and 65.4% respectively. Of the 188 evaluated lesions, 44 were excised with histopathologic examination revealing 31 malignant tumours, including 18 melanomas. With respect to histopathology SIAscopy had a sensitivity of 83.9%. Seven of the 13 benign excised lesions were scored as malignant by SIAscopy resulting in a specificity of 46.1%.
Conclusion: SIAscopy cannot replace the standard of care in skin cancer diagnosis, which includes clinical and dermoscopic examination. However, considering that the technique does not require specific training and expertise, it might represent an additional, relatively cost-effective tool to select lesions for referral.

4) Detection of blood deprived regions in SIAgraph images of pigmented skin lesions

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Abstract: A clinical study using the SIAscope images for the diagnosis of malignant melanoma has shown that the presence of blood deprivation regions within the lesion is strongly associated with malignancy. This paper presents a computer method for automatic detection of the blood deprived regions. The results of the computer method compared to the clinical assessment show very good agreement, with 91% sensitivity and 96% specificity on the set of 95 lesions.

Conclusions: Currently clinicians analyse SIAgraphs visually. The method presented in this paper corresponds very well to experts' assessment. A computer based detection of blood displacement would eliminate the disadvantages of the assessment by human observers, such as the lack of reproducibility. A better method of hair elimination will be sought to prevent the accidental removal of very small blood displacement areas which may happen at present.
SIAgraphs offer a real advantage over other skin imaging methods. Blood displacement, which was found to be a highly significant feature in melanoma diagnosis, is not at all clearly visible in colour images. Further research is underway to automatically detect and quantify others features in SIAgraphs that can be useful in the early detection of melanoma.

5) Assisting diagnosis of melanoma through the "non-invasive biopsy" of skin lesions

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Proceedings of Medical Image Understanding and Analysis 97 Taylor CJ, Noble A, Brady JM Eds. BMVA:1997, 177-180.

Abstract: In order to ensure a good prognosis, malignant melanoma needs to be diagnosed whilst the level of invasion of the tumour within the dermis is small. As an aid to clinicians undertaking this diagnosis a non-invasive system is presented which through the acquisition of a number of images recovers various internal histological information. The efficacy of this approach is assessed through a comparison of the predicted histology with that found through biopsy. The results show that useful histological information can indeed be recovered with particularly sensitive information regarding the dermal invasion of melanocytes.

Conclusion: The efficacy of quantifying various internal histological features through a "non-invasive biopsy" with the aim of assisting clinicians in the diagnosis and monitoring of suspicious skin lesions does indeed seem justified. In particular, the high sensitivity of the system with regard to the identification and quantification of dermal invasion should assist in the early diagnosis of such cases and as such markedly improve their prognosis.

It is not suggested that this approach should replace biopsy as the method of diagnosis for there are numerous features important to formulating a diagnosis that are only available through a microscopical examination of tumour tissue. However, it is envisaged assisting in increasing the sensitivity achieved within the initial screening process which leads to the selection of lesions referred for biopsy. As the system is based on a set of lesion images which could be obtained at a clinic local to the patient, this may also allow a greater proportion of screening to take place at such clinics.

It could be of particular importance in the monitoring of suspicious lesions. For instance, lentigo maligna typically present as large brown macules often on the face and can exist in a benign state for many years. Currently, these are monitored either visually or by standard photographic means with the aim of observing changes which may suggest a progression to invasive lentigo maligna melanoma. By monitoring these using the described system regions of invasive growth could be identified at an early stage assisting greatly in this monitoring process.

This paper concentrated on the use of information relating largely to lesion invasion. As described earlier, however, there are many other histological parameters made available by the system and these could also contribute towards forming a diagnosis. For instance variations in the amount of epidermal melanin and signs of regression are sometimes indicative of malignancy and as such would provide useful information to a clinician.

6) Development and validation of a scoring system for SIAscopic diagnosis of pigmented skin lesions in primary care

J Hunter, FM Walter, PN Hall, M Moncrieff, J Emery, S Cotton

BMC Dermatology2010**10**:9

ABSTRACT

Background: Pigmented skin lesions (PSLs) are a common presenting problem in general practice but differentiating malignant melanomas from other pigmented lesions is challenging. SIAscopy using the Moncrieff scoring system (MSS) increases diagnostic accuracy for melanoma in referred populations but has not previously been tested in primary care.

Objectives: To develop and validate a scoring system for SIAscopic diagnosis of PSLs in primary care.

Methods: Patients presenting with a PSL were recruited from 6 general practices in Cambridgeshire. The following data were obtained for each lesion: clinical history including 7-point checklist; digital photograph; SIAscan image, and digital dermoscopy. SIAscan images were interpreted by an expert and validated against histopathology where possible, or expert clinical review of all available data for each lesion.

Results: 630 lesions from 389 patients were recruited. Most lesions were benign naevi (69.7 %n=439) or seborrhoeic keratoses (22.2 % n =140); 5 (0.79%) were melanoma. The MSS showed the following characteristics for the diagnosis of 'suspicious' (95% CI): sensitivity 54.2% (35.1-72.1%); specificity 77.4% (73.0-81.2%); PPV 12.6% (7.5-20.4%); NPV 96.5% (93.9-98.1%), and for the diagnosis of melanoma: sensitivity 66.7% (20.8-93.8%); specificity 75.9% (71.6-79.7%); PPV 1.9% (0.5-6.8%); NPV 99.7% (98.2-99.9%). A primary care scoring algorithm (PCSA) was developed to improve the ability to distinguish seborrhoeic keratoses and haemangiomas from melanoma. The PCSA had the following characteristics for the diagnosis of 'suspicious': sensitivity 50.0% (18.7-81.2%); specificity 84.2% (78.5-88.5%); PPV 8.6% (3.0-22.4%); NPV 98.3% (95.0-99.4%). Using simulation modelling to provide tighter estimates for the diagnosis of melanoma, the PCSA had a sensitivity of 94.0% and specificity of 83.5% for melanoma.

Conclusions: The PCSA could have a useful role in improving primary care management of pigmented skin lesions. Further work is needed to validate the PCSA in other primary care populations, and to evaluate GP performance after training in SIAscopy use.

7) Evaluation of the MoleMate training program for assessment of suspicious pigmented lesions in primary care.

Wood A, Morris H, Emery J, Hall PN, Cotton S, Prevost AT, Walter FM

Informatics in Primary Care 2008;16:00-00 2008 PHCSG, British Computer Society

Abstract

BACKGROUND: Pigmented skin lesions or 'moles' are a common presenting problem in general practice consultations: while the majority are benign, a minority are malignant melanomas. The MoleMate system is a novel diagnostic tool which incorporates spectrophotometric intracutaneous analysis (SIAscopy) within a non-invasive scanning technique and utilises a diagnostic algorithm specifically developed for use in primary care. The MoleMate training program is a short, computer-based course developed to train primary care practitioners to operate the MoleMate diagnostic tool.

OBJECTIVES: This pre-trial study used mixed methods to assess the effectiveness and acceptability of a computer-based training program CD-ROM, developed to teach primary care practitioners to identify the seven features of suspicious pigmented lesions (SPLs) seen with the MoleMate system.

METHOD: Twenty-five practitioners worked through the MoleMate training program: data on feature recognition and time taken to conduct the assessment of each lesion were collected. Acceptability of the training program and the MoleMate system in general was assessed by questionnaire.

RESULTS: The MoleMate training program improved users' feature recognition by 10% (pre-test median 73.8%, p<0.001), and reduced the time taken to complete assessment of 30 SPLs (pre-test median 21 minutes 53 seconds, median improvement 3 minutes 17 seconds, p<0.001). All practitioners' feature recognition improved (21/21), with most also improving their time (18/21). Practitioners rated the training program as effective and easy to use.
CONCLUSION: The MoleMate training program is a potentially effective and acceptable informatics tool to teach practitioners to recognise the features of SPLs identified by the MoleMate system. It will be used as part of the intervention in a randomised controlled trial to compare the diagnostic accuracy and appropriate referral rates of practitioners using the MoleMate system with best practice in primary care.

8) Practical application of new technologies for melanoma diagnosis Part 1. Noninvasive approaches

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Confirming a diagnosis of cutaneous melanoma requires obtaining a skin biopsy specimen. However, obtaining numerous biopsy specimens—which often happens in patients with increased melanoma risk—is associated with significant cost and morbidity. While some melanomas are easily recognized by the naked eye, many can be difficult to distinguish from nevi, and therefore there is a need and opportunity to develop new technologies that can facilitate clinical examination and melanoma diagnosis. In part I of this 2-part continuing medical education article, we will review the practical applications of emerging technologies for non-invasive melanoma diagnosis, including mobile (smart phone) applications, multispectral imaging (ie, MoleMate and MelaFind), and electrical impedance spectroscopy (Nevisense). (J Am Acad Dermatol 2015;72:929-41.)

Technology	Study	Lesions (melanomas)	Sensitivity (%)	Specificity (%)
SIAscopy 	Moncrieff et al.[45]	348 (52)	83	80
	Haniffa et al.[47]	881 (31)	87	91
	Glud et al.[48]	83 (12)	100	59
	Tomatis[49]	1391 (184)	80	76
	Carrera[50]	1966 (287)	88	80
MelaFind 	Elbaum et al.[57]	246 (63)	95	68
	Friedman et al.[58]	99 (49)	98	44
	Monheit et al.[59]	1632 (127)	98	11
	Wells et al.[60]	47 (23)	96	8
	Hauschild et al.[63]	130 (65)	96	9
Nevisense 	Glickman et al.[68]	178 (12)	92	67
	Har-Shai et al.[69]	449 (69)	91	64
	Aberg et al.[70]	511 (16)	100	75
	Aberg et al.[71]	99 (13)	92	80
	Aberg et al.[72]	210 (62)	95	49
	Mohr et al.[73]			
	Algorithm 1	780 (103)	98	24
	Algorithm 2	715 (162)	99	25
	Malvehy et al.[74]	1946 (265)	97	34

Fig 1. Noninvasive imaging technologies and their performance in melanoma detection. Figures appear courtesy of (top to bottom) MedX Health Corp, MELA Sciences, and SciBase AB.